



Adding Variables to the USDA National Nutrient Database to be Able to Assess Intakes of Added Vitamins E and B₁₂

Gebhardt, S.E., Holden, J.M., Haytowitz, D.B.
USDA, ARS, Beltsville Human Nutrition Research Center,
Nutrient Data Laboratory, Beltsville, Maryland 20705, USA.

Abstract

Nutrient data from the USDA National Nutrient Database for Standard Reference (SR) forms the foundation of the Food and Nutrient Database for Dietary Surveys (FNDDS). Of the 7,000 foods in SR about 2,700 foods are used in the FNDDS. These foods have complete nutrient profiles for the 61 nutrients that are currently used to assess nutrient intake. Changes in the Dietary Reference Intakes for the United States and Canada have created the need for additional forms of vitamins in the database. The Tolerable Upper Intake Level (UL) for vitamin E is based on vitamin E as a supplement or food fortificant. There is a need to have values in the database for added vitamin E separate from total vitamin E. The EAR and RDA for vitamin B₁₂ recommends that adults over 50 years of age should meet most of their requirement by consuming foods fortified with vitamin B₁₂ or a B₁₂-containing supplement. In SR18, nutrient values were included for added vitamin E and added vitamin B₁₂ for all foods used for the FNDDS. Excluding infant formulas, there are about 200 foods that are fortified with vitamin B₁₂. Of these, over 75% are breakfast cereals and about 10% are soy-based meat substitutes and meal replacement products. There are about 100 foods that are fortified with vitamin E. Almost one half of these are breakfast cereals and about 40% are meal replacements. Procedures used to estimate these values will be described.

Introduction

The USDA National Nutrient Database for Standard Reference (SR) (USDA, 2005) forms the foundation for the Food and Nutrient Database for Dietary Studies (FNDDS) (USDA, 2004). About 2700 SR foods are used for the FNDDS. Currently all of these foods have complete nutrient profiles for 61 nutrients. If analytical data were not available for any of these nutrients in the subset of foods used for the FNDDS, the staff of the Nutrient Data Laboratory imputed (calculated) values. In order for new nutrients (food components) of dietary interest to be quantified for What We Eat in America, NHANES (NCHS), they must first be added to all 2700 FNDDS foods in SR. Two components that were added to SR release 18 and will be included in FNDDS 2.0 are added vitamins E and B₁₂.

Added Vitamin E

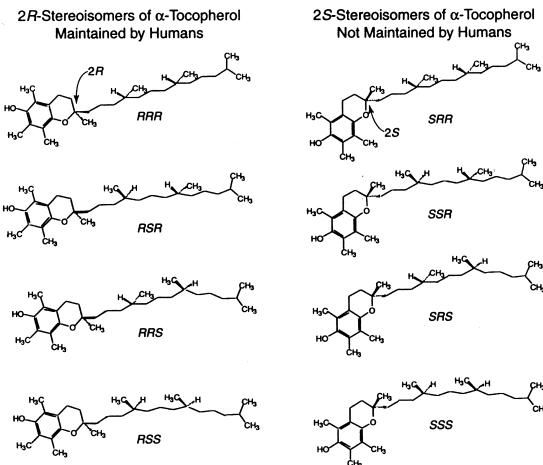
The Dietary Reference Intake for vitamin E established a Tolerable Upper Intake Level (UL) for vitamin E. Hemorrhagic effects were selected as the critical endpoint on which to base the UL for vitamin E for adults. All forms of supplemental α -tocopherol (added vitamin E) are used as the basis of establishing the UL. There is no evidence of adverse effects from the consumption of vitamin E naturally occurring in foods. The UL for Adults >19 years is 1,000 mg/day.

There are two forms of supplementary α -tocopherol that are added to foods 1) all rac- α -tocopherol (synthetic vitamin E) formerly called *dl*- α -tocopherol and 2) RRR- α -tocopherol (natural vitamin E) formerly called *d*- α -tocopherol. Synthetic vitamin E has eight possible stereoisomers. Four of the stereoisomers are in the 2R-stereoisomeric form and four are in the 2S-stereoisomeric form (See Figure1). The 2S-stereoisomers are not maintained in human plasma. For the Estimated Average Requirements (EARs) and the Recommended Dietary Allowances (RDAs), only the 2R-stereoisomers of synthetic vitamin E apply. The ULs apply to any form of supplemental α -tocopherol (IOM,2000).

Added Vitamin B12

In the Dietary Reference Intakes for vitamin B₁₂, the Estimated Average Requirement (EAR) and Recommended Dietary Allowance (RDA) for adults 51 years and older are the same as for younger adults but with the recommendation that B₁₂-fortified foods or B₁₂-containing supplements be used to meet much of the requirement (IOM, 1998).

Figure 1. Stereoisomers of synthetic vitamin E



Procedures

Steps to adding values for added vitamins E and B₁₂ to the SR

- SR is divided into 24 food groups. Each food group was reviewed to determine if any items in the group are fortified. See Table 1. For non-fortified foods, a value of zero was entered.
- From company supplied data or label claims for fortified foods, calculate the amount of the nutrient per 100g. Values for intrinsic vitamins were not present (vitamin B₁₂ in plant products) or extremely low and were not considered. See Vitamin E Conversion Procedures in box
- Enter nutrient values into database for these foods.
- Check if any of the food items are ingredients in multi-ingredient foods; use recipes/formulations to calculate the added nutrient in these foods. (Foods fortified with these nutrients are generally not ingredients in multi-ingredient foods. Recipes were only used to calculate prepared formulas from the concentrate or powder).

Table 1. Status of Added Vitamins E and B₁₂ by Food Group ¹

Vitamins E and B ₁₂ added to all or many items	Vitamin E and B ₁₂ added to a few items ^{2,3}
Infant Formulas	Baked Products
Breakfast Cereals	Beverages
	Dairy and Eggs
	Legumes
	Snacks
	Sweets

¹ Beef; Cereal Grains and Pasta; Fats and Oils; Fast Foods; Fish; Fruits; Lamb, Veal, and Game; Meals, Entrées, and Sidedishes; Ethnic Foods; Nuts and Seeds; Pork; Poultry; Sausages and Luncheon Meats; Soups, Sauces and Gravies; Spices and Herbs; and Vegetables did not contain added E nor B₁₂

² Meat substitutes such as vegetarian burgers and hot dogs are in the Legume food group.

³ Meal replacements, such as be milk-based drinks or energy/nutrition bars, fall into these food groups.

Vitamin E conversion Procedures

Different factors are used to calculate the milligram amount of α -tocopherol from IU of vitamin E depending upon the chemical form of α -tocopherol used to fortify the food where

mg of α -tocopherol in food, fortified food, or multivitamin

= IU of the RRR- α -tocopherol compound * 0.67 and

= IU of the all *rac*- α -tocopherol compound * 0.45.

Synthetic vitamin E is the form most often used to fortify foods. Currently, ingredient labels do not always indicate the type of vitamin E that is added and it is necessary to contact the company. Of the foods in the database, only a few infant formulas are fortified with RRR α -tocopherol (natural vitamin E); these items have a footnote that says that RRR α -tocopherol was added.

The following calculations would be used to convert vitamin E to the 100 gram basis when the Nutrition Facts panel indicates that the food contains 100% Daily Value (DV) per 30 g serving and the form of vitamin E added is all *rac*- α -tocopherol. [DV for vitamin E is 30 IU (FDA, 1993)]:

100% * 30 IU per 30 g serving = 30 IU per 30 g serving

30 IU * 0.45 = 13.5 mg/ 30 g serving

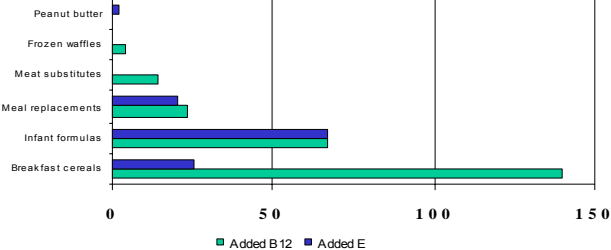
13.5 mg/30 g serving *100 = 45 mg /100g

This is the number to use when comparing intakes to the EAR and RDA for vitamin E. However, because all stereoisomers of synthetic vitamin E apply to the UL, when comparing added vitamin E to the UL the value should be multiplied by 2. Only the few foods—at this time, infant formulas—that have a footnote indicating that RRR- α -tocopherol was the form added, would not be multiplied.

Results and Conclusions

Relatively few foods in the database are fortified with vitamins B₁₂ and/or E. Vitamin B₁₂ is added to 248 foods and vitamin E is added to 115 foods (Figure 2). Less than 15% of the breakfast cereals are fortified with vitamin E and usually contain between 10 and 100% of the DV. More than 70% of the breakfast cereals are fortified with vitamin B₁₂ and usually contain between 25 and 100% of the DV.

Figure 2. Number of foods containing added vitamins B₁₂ and E



Breakfast cereals are the major source of fortified vitamin E for adults and male adolescents (Table 2) (NCHS, 2004). Female adolescents are getting most of their fortified vitamin E from meal replacements/nutrition bars and drinks. Considering that the intake of total vitamin E is 7mg/day (Ahuja, 2004), fortified vitamin E from foods would be an inconsequential contributor to the UL of 1000 mg.

Table 2. % Added vitamin E intake by type of food

Food Type	14 –18 years		19 years +	
	Males	Females	Males	Females
Breakfast Cereals	57	33	59	63
Meal Replacements	41	62	38	32
Meat Substitutes	2	5	3	5

Breakfast cereals were by far the major source of added vitamin B₁₂ for everyone 51 years and older (Table 3) (NCHS, 2004). Individuals in this age group who do not consume fortified breakfast cereal would need to consume either fortified meal replacements or meat substitutes to meet the recommendation to get most of their vitamin B₁₂ requirement from fortified foods or take a dietary supplement.

Table 3. % Added vitamin B₁₂ intake by type of food

Food Type	51 –70 years		71 years +	
	Males	Females	Males	Females
Breakfast Cereals	92	90	94	92
Meal Replacements	4	4	3	4
Meat Substitutes	3	4	1	2
Frozen waffles	1	2	2	2

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